Land-Use Impact on Soil Properties

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In urban areas, land use changes usually increases soil degradation as a consequence of surface sealing and pollution. However, in urban and peri-urban areas, there are areas occupied by agriculture and woodlands, with an essential role in provisioning food and other services to urban areas such as water and climate regulation. Land-use change have a substantial impact on soil properties and soil organic carbon stocks, especially in intensively managed soils (i.e. cropland, vineyard land use). Tillage, pesticides, and fertilizer applications were presumably the reasons for altered soil quality properties. Intensively used areas may reduce soil ecosystems services such as the capacity for flood retention and carbon sequestration.

Keywords: soil management ; soil degradation ; land-use ; flood retention ; carbon sequestration

1. Introduction

Near the cities, both agricultural land and forests are being rapidly converted into urban areas as a consequence of urban sprawl. This land-use change is decreasing the ecosystem services drastically (e.g., air pollution regulation, water storage and infiltration, flood regulation, carbon sequestration, and food provided by these areas)[1]. Moreover, land use management has substantial impacts on soil quality and affect the hydrological response. The conversion of agriculture areas to urbanized areas implies the loss of food production areas (e.g., orchards, vineyards or croplands) and a decrease in food security[2][3]. The reduction of forests and agricultural land close to the cities increases the demand for food if areas located from the city, amplifying the circular economy and the impact on global climate change[4].

Agriculture near urban areas are an important source of income and provision of food to local markets[5]. Other important aspects related to agriculture is the type of management carried out. Tillage and the use of agrochemicals are known to degrade soil properties (e.g. low organic matter content, hydraulic conductivity and aggregate stability) and reduce soil quality when compared to forest soils[6]. There is a need for sustainable agriculture also in urban areas. Agricultural and forested areas in urban areas are key to mitigate the impacts of floods since these are areas of water infiltration and retention[7]. Therefore, it is key to know the hydrological response to these areas. Also, they can and alleviate the urban effect on greenhouse emissions and increase soil organic C stocks (SOCS).

Agriculture practices in the urban areas affect soil physical, hydrological, and C sequestration. Therefore, comparing different land management practices is crucial to understand the impacts of urban agriculture on the capacity to mitigate floods and increase C sequestration in urban areas. The large cover of forests and agricultural areas provide an important number of benefits such as food supply, disaster mitigation (e.g., water infiltration) and mitigate climate change (e.g., carbon sequestration or buffering temperature and humidity). Areas with high urbanization development are more vulnerable to environmental hazards and significantly contribute to global climate change[8][9]. The aim of this work is to study the impacts of agricultural and forest land use in peri-urban Stagnosols in Zagreb on the capacity to mitigate flood impacts and C sequestration.

2. Conclusion

The high compaction in vineyard and cropland land use were attributed to the conventional treatment applied (e.g., tillage, tractor traffic and agrochemicals application). On the other hand, conventional management is also responsible for decreased water holding capacity, porosity, aggregate stability and infiltration. Soil organic matter and SOCS were significantly higher in forest compared to the other land uses as a consequence of the absence of human disturbance. Orchard land use is in an intermediary position between forest, and vineyard/cropland land uses. Orchard land use management (diverse fruit trees, no-tillage, and soil protection with residues from the grass cuts) are recognized in this work as environmentally friendly.

The present study reveals that unsustainable land-use practices (vineyard and cropland land use) can decrease important soil functions provided by the ecosystem. This is particularly critical in areas located in urban areas since the capacity to mitigate floods is reduced. Our study showed that orchard and forest land uses have a high capacity of water infiltration and are very likely to mitigate flood impacts. Contrary, poor management practices, especially in sloped areas (e.g., vineyard land use), can enhance flood risks. Forest and orchard land uses may act as a carbon sink, while intensive practices carried out at vineyard and cropland likely contribute to carbon losses.

Although agriculture is crucial to ensure food security and increase the income of the urban population[10], intensive agriculture reduce important soil functions and regulating ecosystem services such as flood retention and carbon sequestration. Decreased tractor traffic, reduced or no-tillage management, a transition to organic production, wide crop rotation, and organic fertilization in these plots would be beneficial for soil quality[11][12]. The implementation of crop diversification practices would be relevant to reverse soil degradation process. For instance, the management applied in orchard land use is a good example of how to preserve soil quality. The preservation of soil quality should be a national priority. Therefore, it is key to maintain forests in urban areas.

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